# Section 10

## ALI Technology Infusion Strategy




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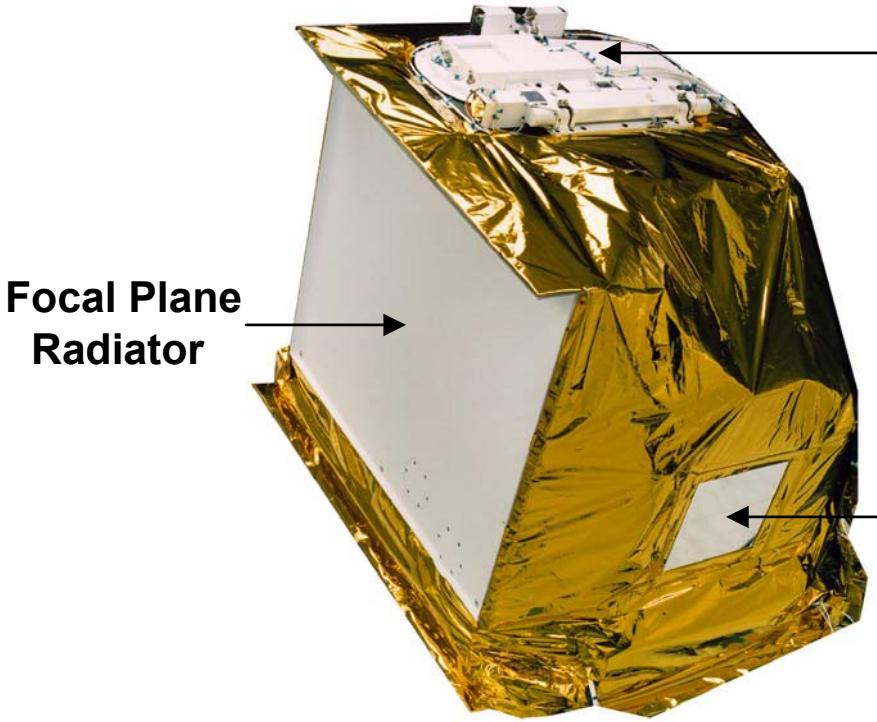
# Topics of Discussion

- ***Introduction***
- ***Technology for Infusion***
- ***Technology Infusion Process***
- ***Summary***

# *Introduction*

# ALI Instrument






- ***Wavelength range*** — ***0.4 –2.4 μm***
- ***Number of multi-spectral bands*** — ***10***
- ***Panchromatic band ground sampling distance (gsd)*** — ***10 m***
- ***Visible, near infrared, & short wavelength infrared gsd*** — ***30 m***
- ***Data rate*** — ***100 Mb/s***
- ***Mass*** — ***90 kg***
- ***Power*** — ***100 W***


# Candidate Missions for Technology Infusion



- ***Landsat Data Continuity Mission***
- ***Other U.S. Government-selected missions***

# Technology Infusion Path



# *Technology for Infusion*

- *Wide Field of View Optics*
- *Silicon Carbide Mirrors*
- *Non-Cryogenic Multi-Spectral Focal Plane*
- *Other Technologies*

# Wide Field of View, Silicon Carbide Optics

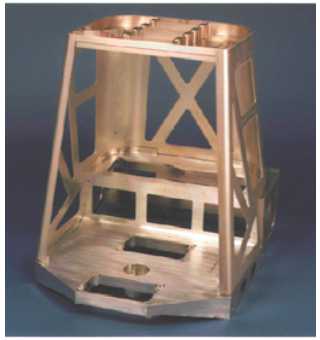


**ALI silicon carbide mirror wavefront & Invar structure validations are adequate; low scatter not achieved**

*M1 Mirror*

1. <u>EO-1 Telescope Technology</u>
   - A. Low scatter silicon carbide mirrors need development and tests of combined stray light and wavefront performance
   - B. Invar structure validation adequate
2. <u>All Silicon Carbide Telescope Technology</u>
   - A. Low scatter silicon carbide mirrors need development and tests
   - B. Silicon carbide composite structure requires material tests, design, analysis, fabrication, assembly, and test
3. <u>Aluminum Technology</u>
   - A. Aluminum mirrors need development and test
   - B. Aluminum structure needs analysis and test

**Development and test validation suggested for silicon carbide or aluminum telescope technologies**



***Aluminum Telescope Structure***

# Focal Plane Array and Radiator

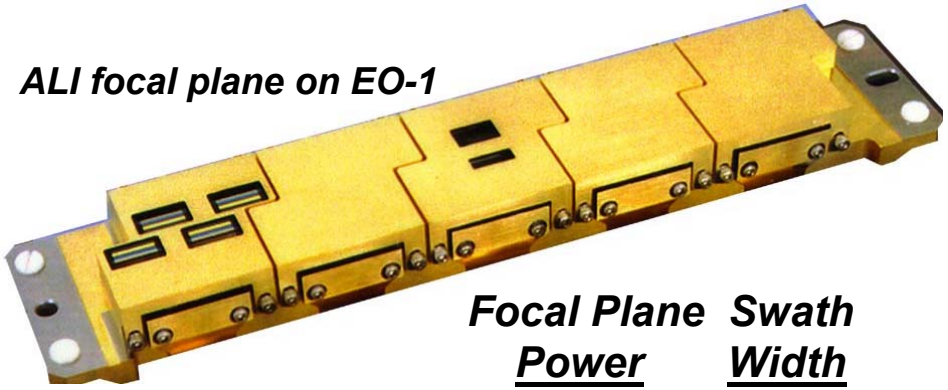


**EO-1 flight validation of focal plane design (mounting frame, rail, thermal link, radiator, heaters, temperature sensors, and cables) adequate for seven-band visible and near infrared, three-band short wave infrared**

**Seven visible and near infrared filter designs validated; three short wave infrared filter designs validated**

**New focal plane and cable design needed for more than seven visible or near infrared, or more than three short wave infrared bands; ALI focal plane design and temperature not appropriate for thermal (10.4 - 12.5 μm) band**

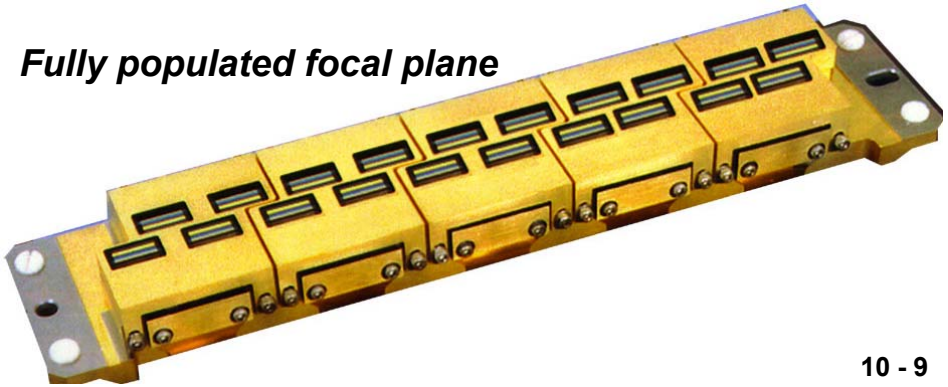
***ALI focal plane on EO-1***



| ***Focal Plane Power*** | ***Swath Width*** |
|---|---|
| ***15 W*** | ***37 km*** |
| ***50 W*** | ***185 km*** |

**Five-fold replication of focal plane sensor chip and filter assemblies for full coverage**

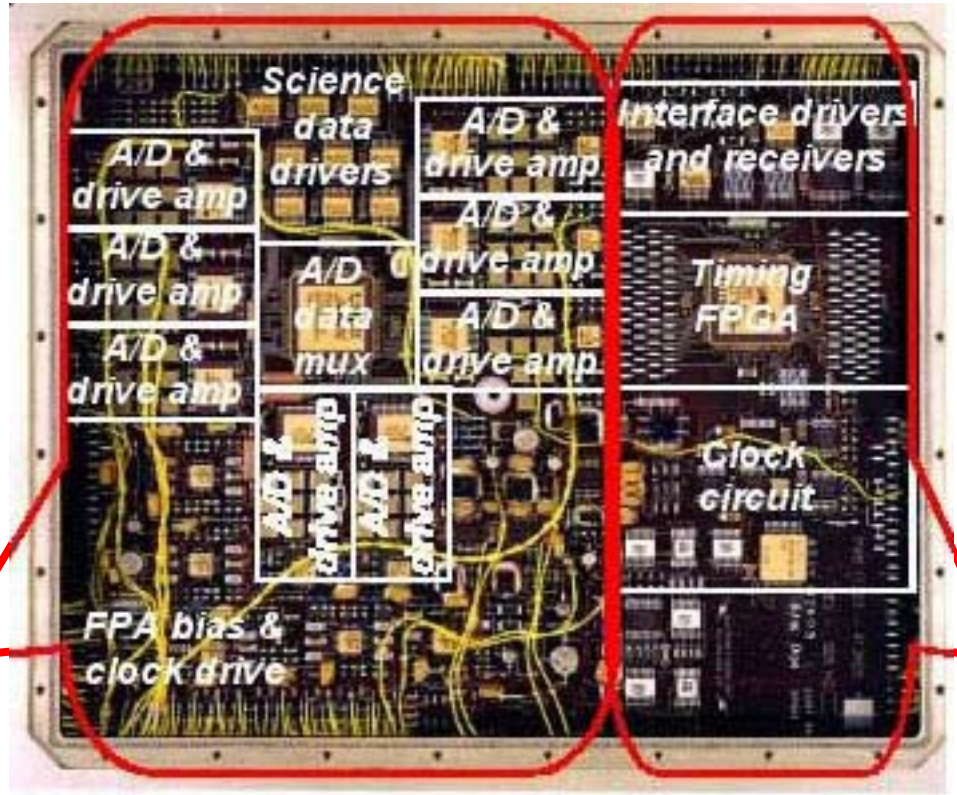
***Fully populated focal plane***



# Focal Plane Electronics for Fully Populated Focal Plane



**Simplify science data output format and add redundancies for reliability**

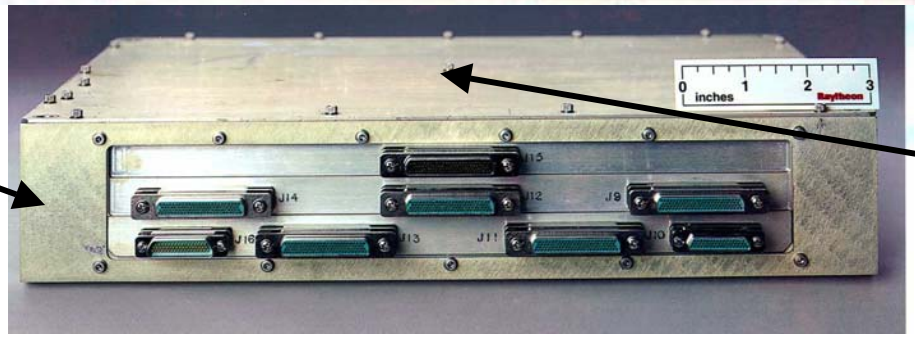



**Reproduce MS-Pan circuits five-fold for full focal plane**

**Timing circuits adequate for full focal plane**

**New board layout to reduce thermal control noise, and to remove wedge and grating circuits and jumper wires**

**Chassis, connectors, and board packaging adequate for full focal plane**

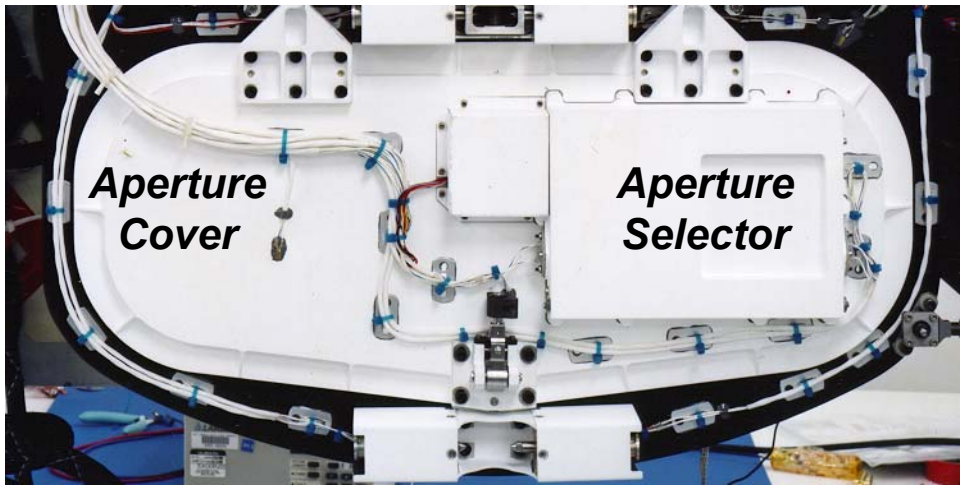


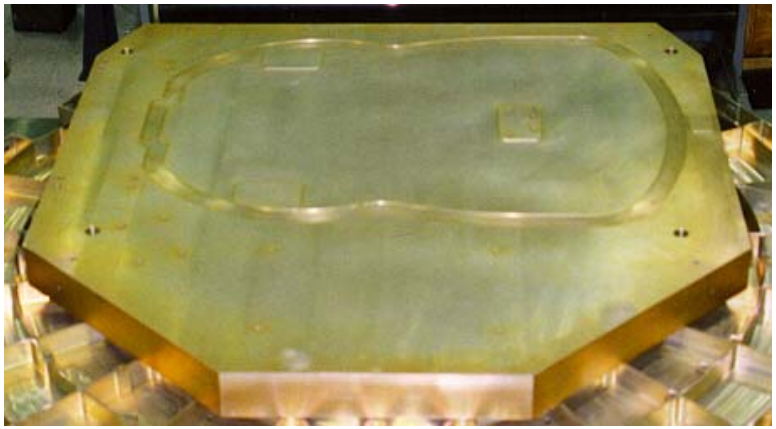

**Relocate converters from ALI Control Electronics onto FPE cover-radiator**

# Mechanisms, Pallet, & Telescope Flexures



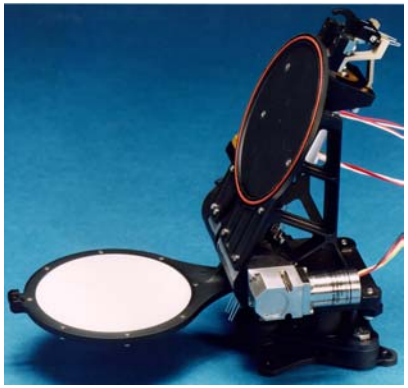
***EO-1 life tests completed (open cover: 3,900 cycles, calibration: 240 cycles); other missions may need more cycles***



***Instrument Pallet***

***Telescope Flexural Mounts***

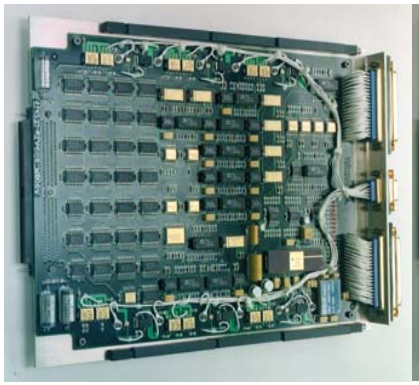


***Calibration Diffuser***

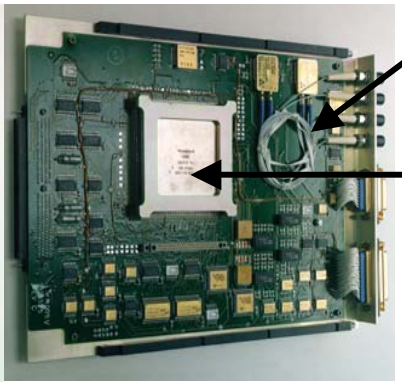
# ALI Control Electronics



***Reduce temperature circuits and sample rates***



***Analog Signal Conditioning***



***Remote Services Node***

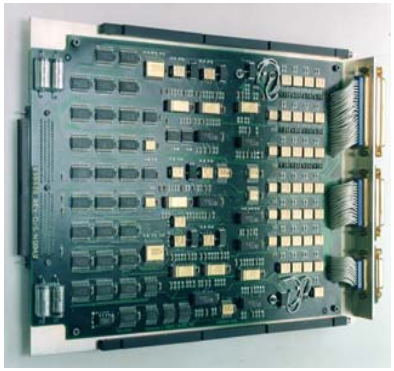
***Replace 1773 fiber optic transceivers with 1553 links***

***Electronic Services Node no longer available, find existing stock or replace***

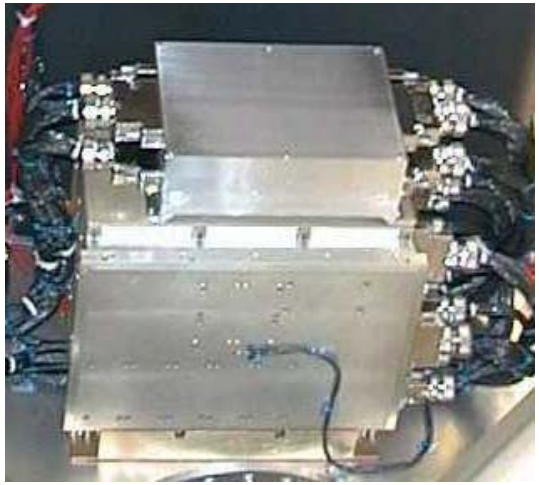
***Minor software mods for bus with CCSDS; operating system software mods needed for other protocols***

***Reduce noise with filters and by slowing multiplex rise time***

***New board layout to replace jumpers with traces and add redundancy for reliability***



***Mechanisms and Thermal Control***



***Chassis with filter box, power module, and connectors***

# ALI Accomplishments & Limitations



- ***Advanced Land Imager validates technology in flight***
  - ***Telescope validation***
    - *Wavefront performance over full field of view validated*
    - *Low scattering not achieved with silicon carbide mirrors*
    - *Aluminum may provide economical alternative to silicon carbide*
  - ***Focal plane validation***
    - *Constrained cost and schedule limited focal plane size, swath width, on-board data storage, data down link, orbital lifetime, and operating duty cycle*
    - *Additions to seven visible and near infrared and three short wave infrared bands would require new focal plane design*
    - *Different band specifications would require new filters*
    - *Thermal band not addressed by ALI*
- ***Some ALI structural, optical, and electronics features are not needed (e.g., features related to the Wedge Imaging Spectrometer and Grating Imaging Spectrometer, numerous diagnostic sensors)***

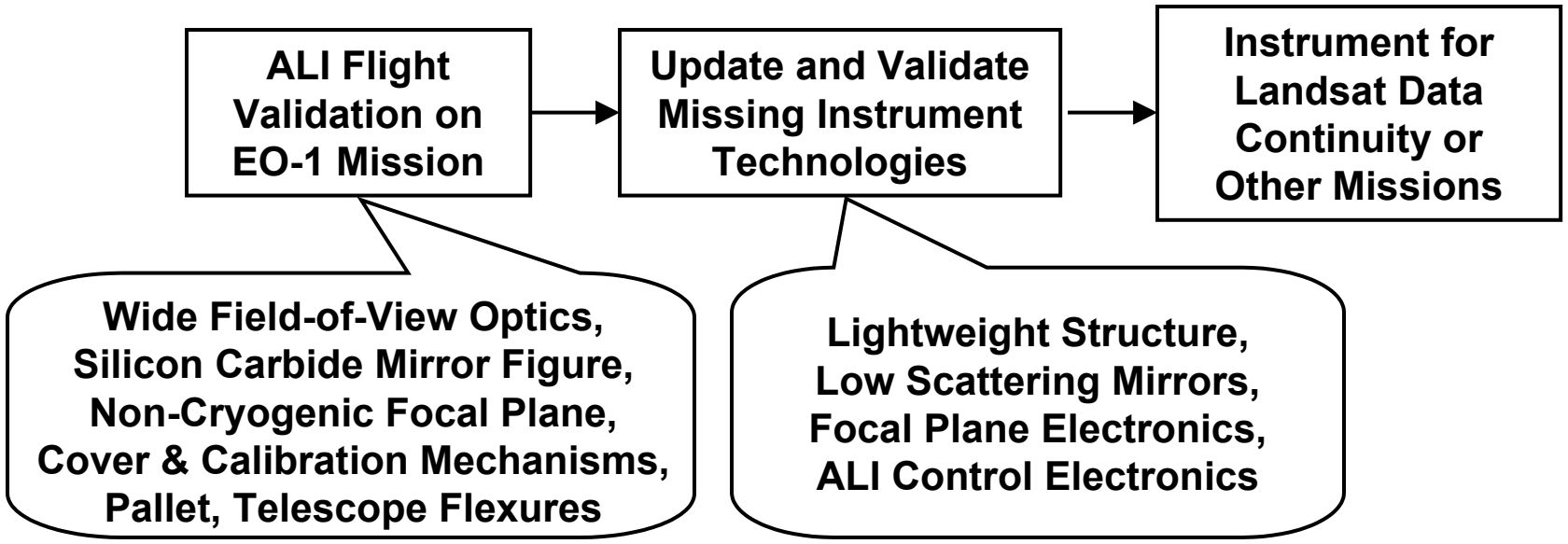
# Additional ALI Flight Validation



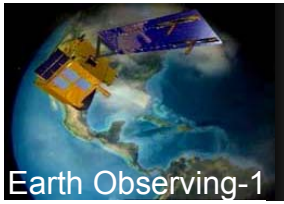
- ***Autonomous yaw steering***
- ***Variations in instrument performance for different:***
  - ***Frame rates***
  - ***Integration times***
  - ***Focal plane temperatures***
  - ***Solar array drive operations***

# Technology Infusion Path





# *Technology Infusion Process*



# Technology Infusion Process



- ***Technology Workshop and Technology Validation and Transfer Forum***
  1. ***Completed January 9-11, 2001***
  2. ***In Progress August 15-16, 2001***
  3. ***Planned for March 2002***
- ***Comprehensive ALI briefings at MIT Lincoln Laboratory***
  - ***Tentatively scheduled for September 24-25, 2001***
- ***LDCM Formulation Phase technology transfer and infusion support may be requested***
  - ***NASA-sponsored MIT Lincoln Laboratory support***
- ***LDCM Implementation Phase technology transfer and infusion support to be assessed during Formulation Phase***
  - ***NASA-sponsored MIT Lincoln Laboratory support***

# Technology Infusion Documentation



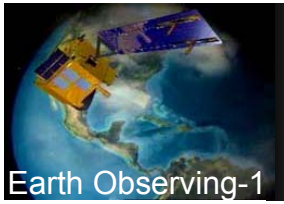
- ***NASA-sponsored MIT Lincoln Laboratory documentation expected to be provided by the Government to contractors***
  - ***System and subsystem Interface Control Documents***
  - ***Available design drawings and parts lists (some released and some red-lined)***
  - ***Programs for numerically-controlled machining of some parts***
  - ***Available process procedures***
  - ***Test plans, procedures, and reports***
  - ***Review presentations, action items, and responses***
  - ***System and subsystem requirements***
  - ***Software and software description for instrument test, status monitoring, operation, and calibration***
  - ***System and subsystem schedule experience***
  - ***Project reports***

# Other Possible Technology Infusion



- ***NASA-sponsored MIT Lincoln Laboratory capabilities to be assessed for possible availability during the LDCM Implementation Phase***
  - ***Available fixtures***
  - ***Facilities, as available***
    - *Clean thermal-vacuum chamber*
    - *Thermally-controlled chambers*
    - *Vibration test systems*
    - *Clean assembly area*
    - *Electrostatic-discharge-controlled assembly area*
    - *Instrumented bake-out chamber*
    - *Calibration facilities and instrumentation*
  - ***Structural-thermal model (unpolished mirrors and thermal model focal plane) with operating ALI Control Electronics***
  - ***Analysis, design, fabrication, assembly, and calibration capabilities***
  - ***Potential spare parts, aluminum telescope structure***

# *Summary*



# ALI Technology Infusion Strategy Summary



- ***New Millennium Program developed Advanced Land Imager technology for validation***
- ***Advanced Land Imager ground calibration completed and orbital validation initiated for future missions***
- ***Technology infusion process defined***